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AGE OF ENTRANCE INTO THE FIRST GRADE AS RELATED TO ARITHMETIC ACHIEVEMENT.

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THIS INVESTIGATION WAS DESIGNED TO ASSESS THE INFLUENCE OF AGE OF ENTRANCE INTO THE FIRST GRADE ON ARITHMETIC ACHIEVEMENT. THE SCORES ON ARITHMETIC ACHIEVEMENT TESTS WERE COMPARED FOR 378 LATE AND EARLY ENTRANT BOYS AND GIRLS IN THE FIRST TO SIXTH GRADES. THE LATE ENTRANTS WERE BETWEEN 8 AND 9 MONTHS OLDER THAN THE EARLY ENTRANTS. THEORETICALLY, AN EARLY START SHOULD NOT RESULT IN SIGNIFICANT GAINS OF LONG TERM DURATION. IN TESTING THIS CONCLUSION, THE ARITHMETIC ACHIEVEMENT SCORES WERE COMPARED ON THE BASIS OF BOTH GRADE AND AGE. FOR BOTH BOYS AND GIRLS, THE RESULTS SHOWED THAT, MEASURED ON THE BASIS OF GRADE, THE ARITHMETIC ACHIEVEMENT SCORES WERE HIGHER FOR THE LATE ENTRANTS, BUT, MEASURED ON THE BASIS OF EQUATED AGE, THE EARLY ENTRANTS SCORED HIGHER. THESE RESULTS SUPPORT OTHER FINDINGS IN THE AREA AND LEAD TO THE CONCLUSIONS THAT (1) PUPILS IN THE AMERICAN GRADE SCHOOLS CAN LEARN EARLIER IN LIFE THAN NOW THOUGHT, (2) THEY CAN LEARN MORE COMPLEX ARITHMETIC, AND (3) SUCH LEARNING MAY HAVE AN ENDURING CUMULATIVE EFFECT AT AGE 11. PERHAPS, AS A SUGGESTION, THE PRESENT ARITHMETIC CURRICULUM SHOULD BE REEVALUATED, FOR IT HAS TOO FREQUENTLY BEEN FOUND INSUFFICIENTLY STIMULATING TO THE PUPILS. THIS PAPER WAS PRESENTED TO THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION, (CHICAGO, FEBRUARY 7, 1968). (WD)

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This investigation was designed to assess the influence of age of entrance to first grade on arithmetic achievement.[1] Developmental theory holds that an early start will not result in significant gains of long-term duration. This proposition was tested by comparing the achievement of early and late entrants to the first grade not only by grade but also at age as they advanced through school. Early entrants have the advantage of an extended period of schooling when comparisons are made at age.

The subjects were 426 students of Lincoln Consolidated Laboratory School of Eastern Michigan University, Ypsilanti, Michigan, who had the necessary requirements of kindergarten attendance, intelligence, and achievement test data. These subjects were divided into three equal groups of 142 early, 142 average, and 142 late entrants. As many as possible of the early and late entrants were matched according to sex, intelligence, and social class, with the result that 41 pairs of boys and 49 pairs of girls were available for study.

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[1] Joseph Ilika, Age of Entrance into the First Grade as Related to Scholastic Achievement, unpublished doctoral dissertation, The University of Michigan, 1963.

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The late entrant boys were 81.05 months old when they entered first grade and the early entrants 72.56 months old. The late entrant girls were 81.51 months old at age of entrance to first grade and the early entrant girls, 72.06 months old. The late entrants were between eight and nine months older than the early entrants when they started first grade and this age advantage was subsequently maintained in all comparisons made at grade level. By selection there is no individual in the late entrant group who is in the early entrant group.

Early boy entrants had a mean IQ of 103.63 and late boy entrants a mean IQ of 102.63. The difference between these means was not significant at the 5 per cent level.

The early and late entrants were first compared by grade on total arithmetic achievement age scores on the Progressive Achievement Test and the California Achievement Test. The *t*-test was applied to test the significance of the differences between the mean achievements of the early and late entrants in each grade from one through six.

The comparisons at age were made by estimating the mean achievement ages of the early entrants at the same chronological ages as those of the late entrants. The differences between the mean achievement ages of the late entrants and the estimated means of the early entrants were tested for significance by the *z*-test.

The Influence of Age of Entrance on Arithmetic Age

Comparison of Mean Arithmetic Age of Late and Early Entrant Boys at the Same Grade Level. -The data in Table 1 show that the late entrant boys consistently attained higher mean arithmetic ages than the early entrants in all but the first grade, which was made up of a very small sample, and to which much meaning cannot be ascribed. Of the differences between the means of late and early entrant boys, those of three of the remaining five grades, grades two, three, and five, showed statistical significance. The data in this table are portrayed by growth curves in Figure 1.

TABLE 1

COMPARISON OF THE MEAN ARITHMETIC AGE OF LATE AND EARLY ENTRANT BOYS AT THE SAME GRADE LEVEL

		Late Entrants		Early Entrants			
Grade	N	C. A. m	Ar. A. m	C. A. m	Ar. A. m	Ar. A. $\overline{D}$	$\frac{t}{}$
(1)	7	88.57	89.57	80.29	90.43	-.86	.41
(2)	39	101.53	103.15	92.11	98.9	4.25	3.63**
(3)	33	113.11	116.03	104.68	110.52	5.51	3.17**
(4)	27	125.69	123.44	116.80	122.15	1.29	.69
(5)	29	137.53	137.45	128.57	132.34	5.11	2.08*
(6)	33	148.98	145.90	140.44	143.36	2.54	1.02

Figure 1 shows that the early entrants in a very small sample achieved higher arithmetic age means in the first grade but that, after the first grade, the late entrants consistently attained higher arithmetic age scores. The growth curves also s how that the late entrants maintained above-grade standard performances throughout the six years and that the early entrants' curve declined to an insignificant degree below the norm in the sixth grade.

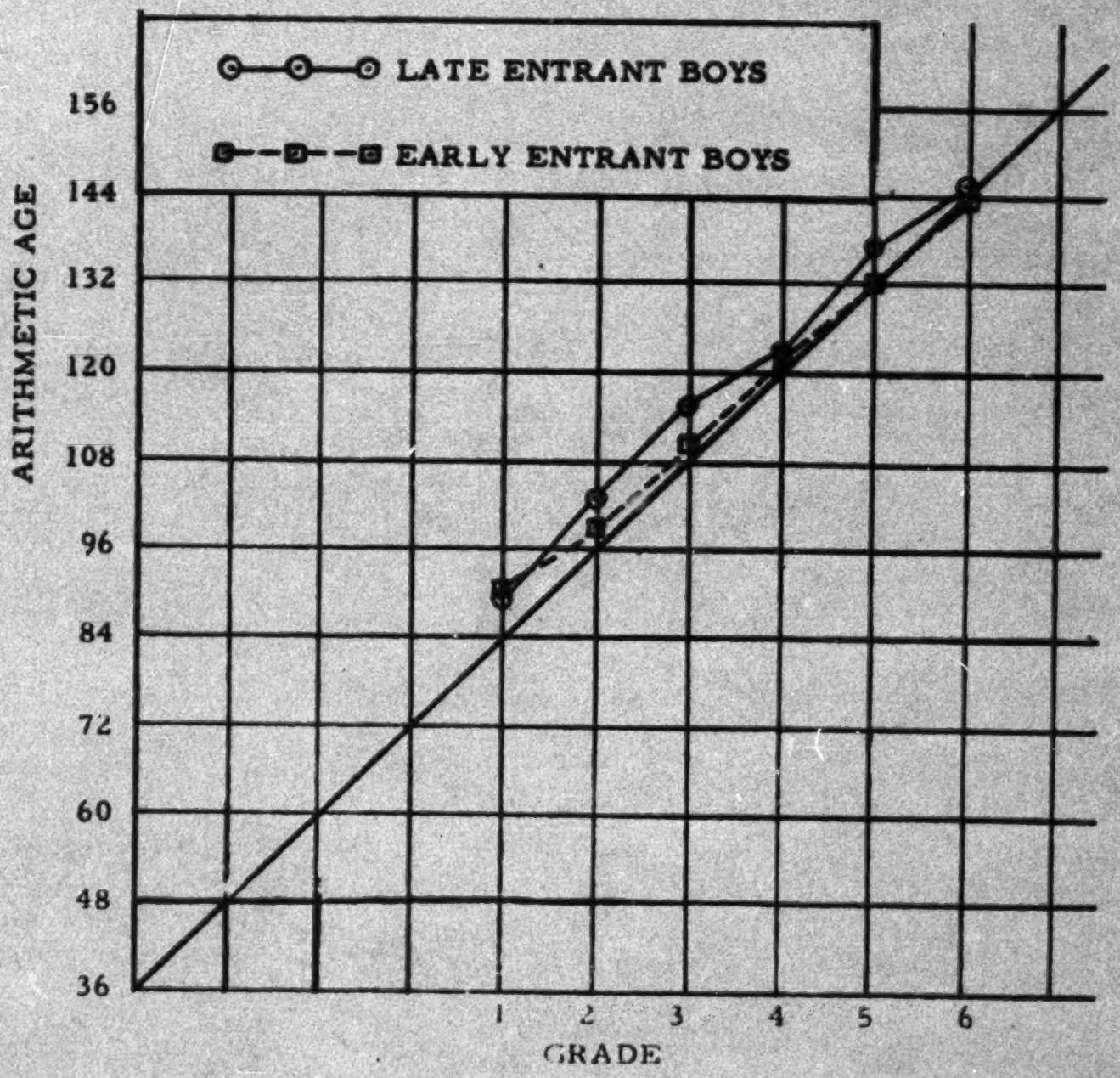

Fig. 1. Late entrant and early entrant mean arithmetic age at grade.

Comparison of Mean Arithmetic Age of Late Entrant Boys with the Estimated Mean Arithmetic Age of the Early Entrant Boys at Age. - The results in Table 2 clearly show that the early entrants attained higher estimated mean arithmetic achievement ages in all of the age comparisons. The comparison at 88.57 months of age should not be treated as firm because it is difficult to get a good estimate of the variance for such small samples. The second comparison at 101.53 months of age yielded a statistically significant difference between means at the 1 per cent level. The comparison at 125.69 months was statistically significant at the 5 per cent level.

TABLE 2

COMPARISON OF MEAN ARITHEMIC AGE OF LATE ENTRANT BOYS WITH THE ESTIMATED MEAN ARITHMETIC AGE OF THE EARLY ENTRANT BOYS AT AGE

Late and Early Entrant Age m	Late Entrants		Early Entrants				
	m	s^2	m	s^2	D	S. E.	z
88.57	89.57	1.52	94.52	.24	-4.95	±1.32	3.96 **
101.53	103.53	1.22	107.44	1.18	-4.29	±1.55	2.77**
113.11	116.03	3.52	118.61	2.08	-2.58	±2.37	1.09
125.69	123.44	2.66	129.85	3.33	-6.41	±2.45	2.62**
137.53	137.53	3.69	140.66	3.04	-3.21	±2.57	1.24

The growth curves based on Table 2 may be viewed in Figure 2. This figure shows that when comparisons are made at age, the early entrants maintained their initial advantage. In fact, their growth curve continued to be above the diagonal test norm line, indicating that they consistently achieved above the age norms as well. On the other hand, the curve of the late entrants was consistently below that of the early entrants and above the test norm for only the first half of the elementary school grades.

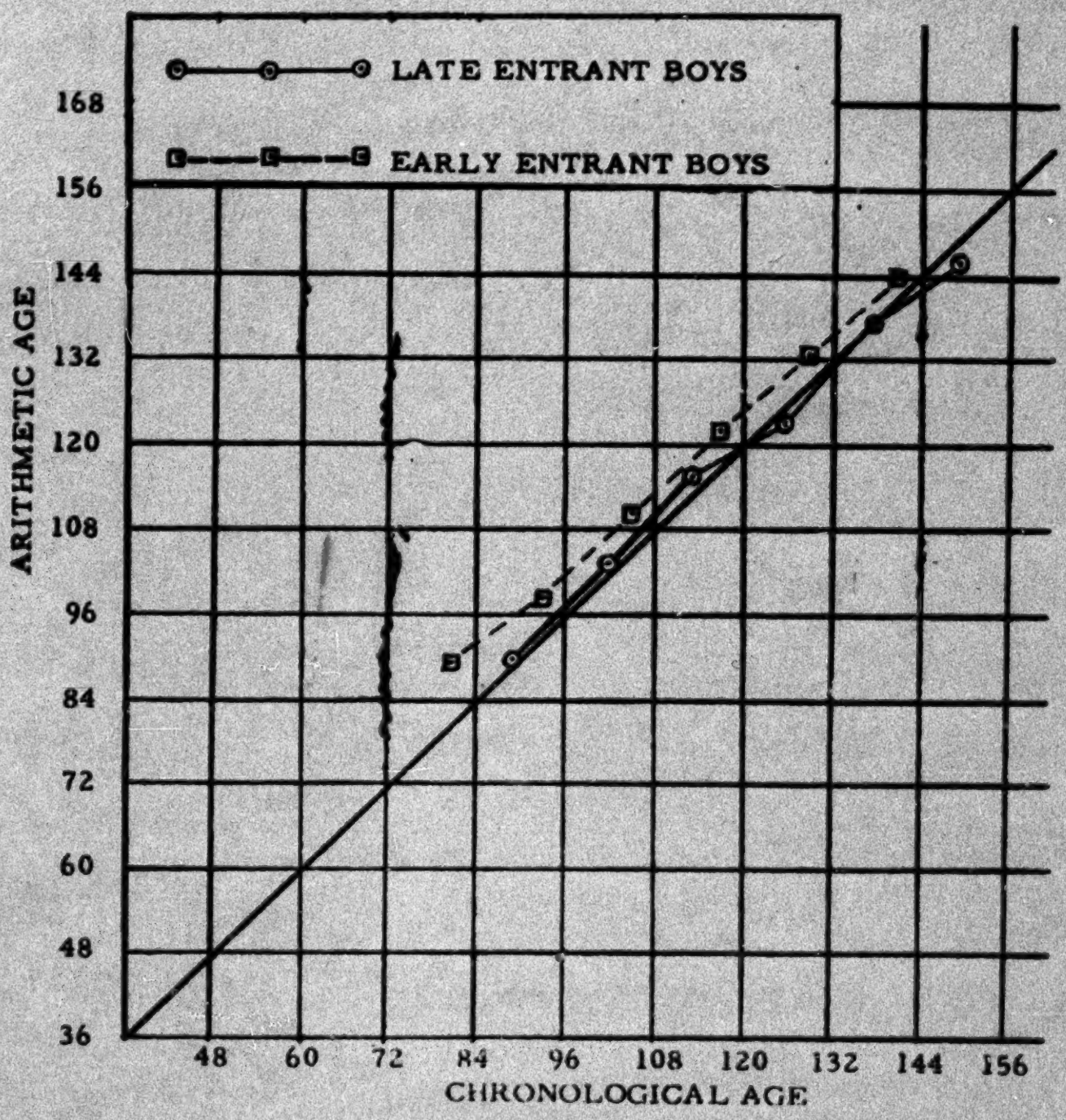

Fig. 2. Late entrant and early entrant mean arithmetic age at chronological age.

Comparison of the Mean Arithmetic Age of Late and Early Entrant Girls at the Same Grade Level. -Table 3 shows that the late entrant girls had higher arithmetic ages than the early entrants in all grades. However, only two of the differences between the means were statistically significant at the 5 per cent level or less. The important result of this set of comparisons is that the difference between the means in the sixth grade, although favoring the late entrants, was not statistically significant.

TABLE 3

COMPARISON OF THE MEAN ARITHMETIC AGE OF LATE AND EARLY ENTRANT GIRLS AT THE SAME GRADE LEVEL

		Late Entrants		Early Entrants			
Grade	N	C. A. m	Ar. A. m	C. A. m	Ar. A. m	Ar. A. $\overline{D}$	t
(1)	10	91.1	94.3	81.00	89.2	5.1	1.53
(2)	46	101.67	102.5	92.33	101.24	1.26	1.2
(3)	38	113.92	115.71	104.60	113.24	2.47	1.95
(4)	37	126.07	129.35	116.16	123.32	6.03	3.11**
(5)	36	137.67	137.92	128.5	133.78	4.14	2.05*
(6)	43	149.66	147.67	139.22	145.14	2.53	1.09

The growth curves in Figure 3 based on Table 3 show that both groups consistently achieved above the test norms throughout the six grades and that the early entrant curve was consistently below the late entrant curve.

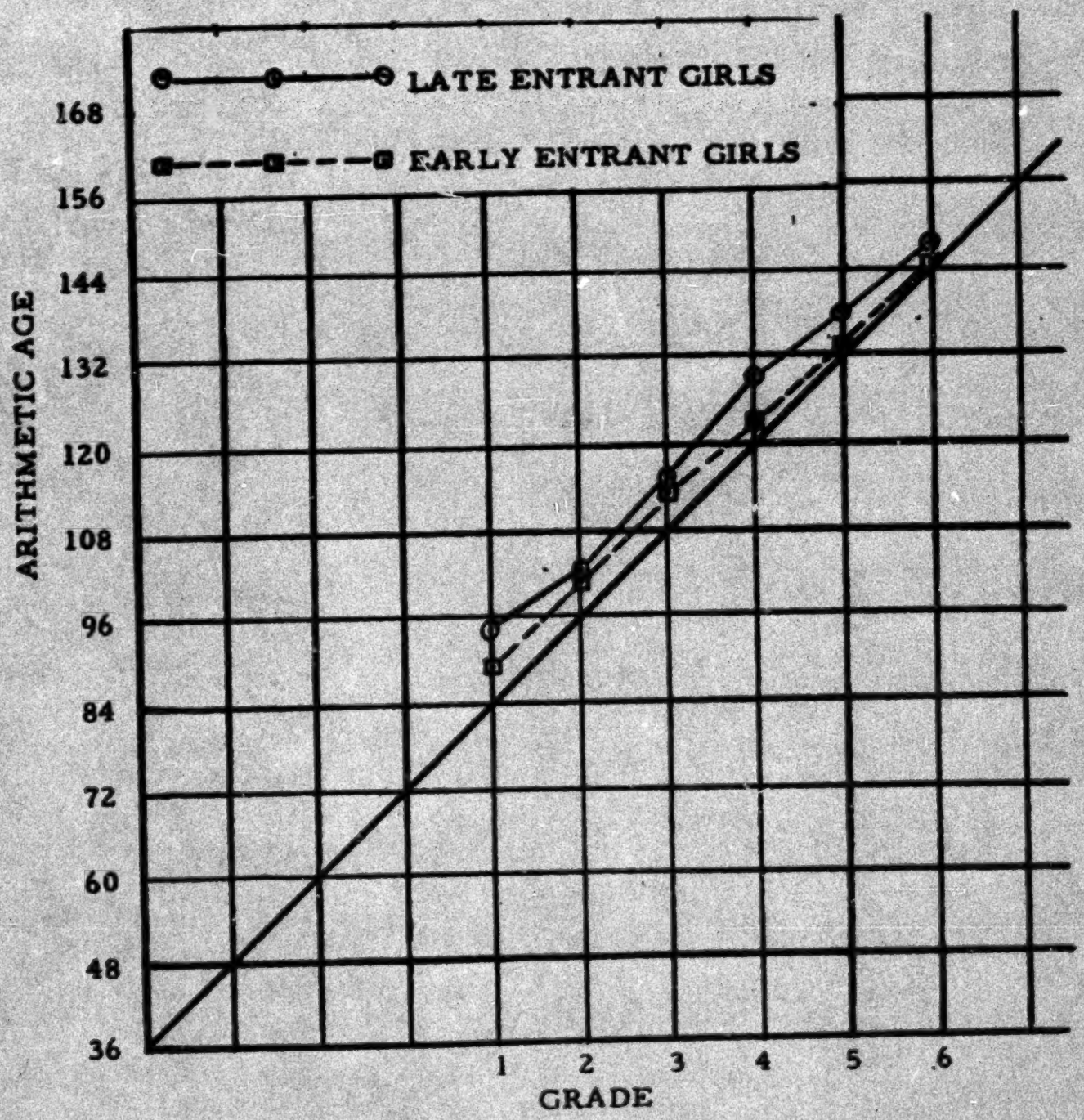

Fig. 3. Late entrant and early entrant mean arithmetic age at grade.

Comparison of Mean Arithmetic Age of Late Entrant Girls with the Estimated Mean Arithmetic Age of the Early Entrant Girls at Age. - The results in Table 4 reverse the findings of the grade comparisons and show clearly that the early entrants consistently attained higher estimated mean arithmetic ages. Not only were the estimated means higher, but the means were statistically significant at or less than the 1 per cent level in two of the five comparisons. The fact that the early entrant girls maintained higher estimated mean arithmetic ages that survived at a statistically significant level in the eleventh year indicates that in arithmetic age comparisons for the girls there was indeed a real difference in achievement.

TABLE 4

COMPARISON OF MEAN ARITHMETIC AGE OF LATE ENTRANT GIRLS WITH THE ESTIMATED MEAN ARITHMETIC AGE OF THE EARLY ENTRANT GIRLS AT AGE

Late and Early Entrant Age m	Late Entrants		Early Entrants				
	m	s^2	m	s^2	D	S. E.	z
91.1	94.3	4.00	100.03	2.09	-5.73	±2.47	2.32*
101.67	102.5	.88	110.40	.76	-7.90	±1.28	6.17**
113.92	115.71	1.30	121.37	1.43	-5.66	±1.65	3.42**
126.07	129.35	2.89	131.72	2.34	-2.37	±2.29	1.03
137.67	137.92	1.43	143.50	3.58	-5.58	±2.24	2.49*

The means from Table 4 are depicted in Figure 4, which shows that the early entrant growth curve is consistently above the late entrant growth curve as well as as above the test norm. The last part of both curves also shows diverging trends in that the early entrants made higher arithmetic age scores than the late entrants, as the growth curve in the last two observations shows.

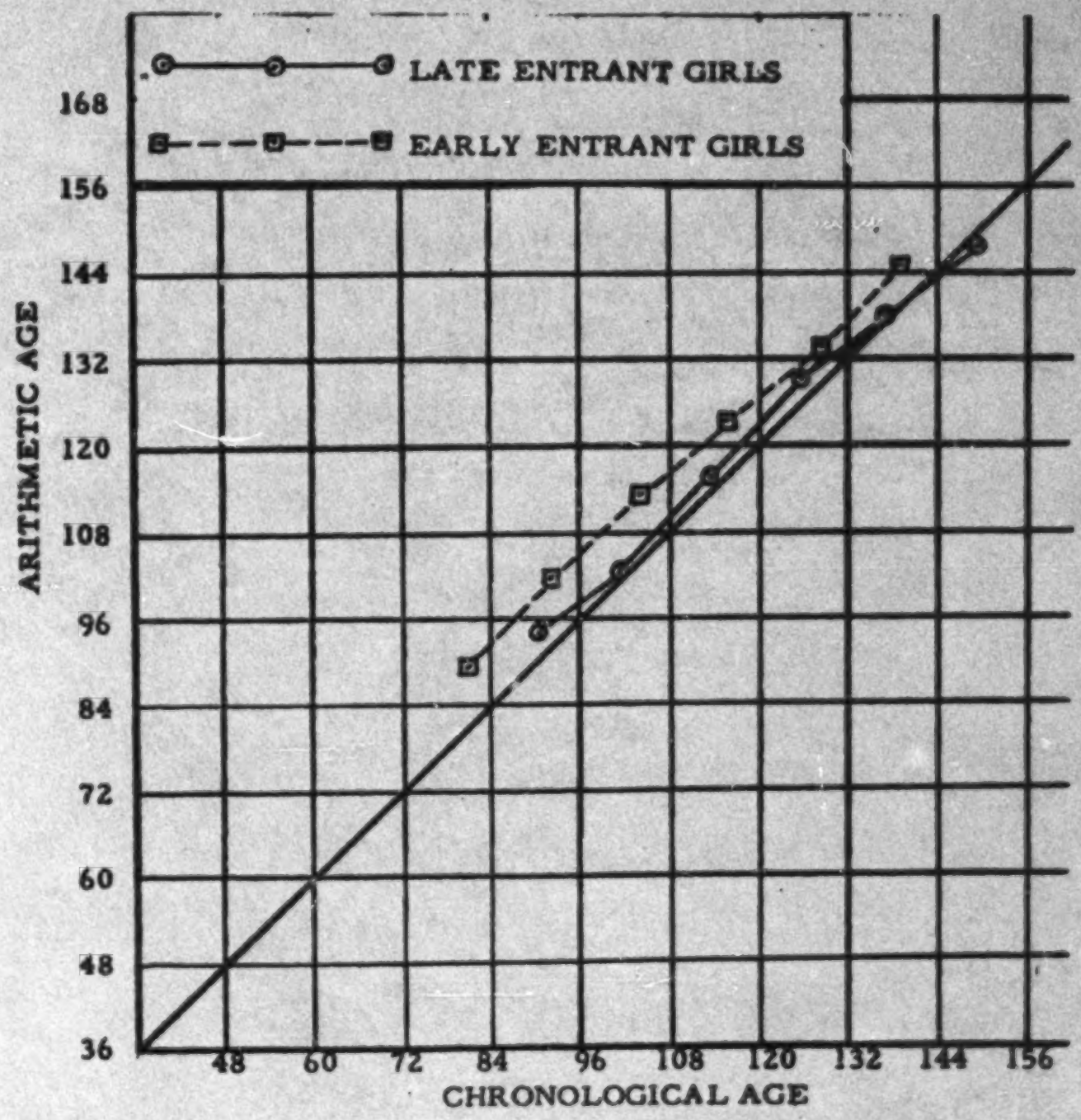

Fig. 4. Late entrant and early entrant mean arithmetic age at chronological age.

Discussion

The arithmetic age comparisons at grade level revealed that the late entrants had higher mean arithmetic ages in 11 of the 12 grade comparisons. Of the 11 differences favoring the late entrants, only 5 were statistically significant.

The arithmetic achievement age comparisons at the same age completely reversed the findings of the grade comparisons. Every single one of the ten arithmetic age-comparisons favored the early entrant boys and girls. The early entrants were superior in arithmetic age achievement at 137 months of age, and the difference favoring the early entrant girls was statistically significant at the 5 per cent level. The early entrant boys also had higher arithmetic age means, but the difference between the early and late entrant means at 137 months of age was not statistically significant.

The evidence clearly indicates that when girls enter first grade early their subsequent arithmetic achievement is high. In this investigation the superiority in arithmetic of the early entrant girls confirms the findings of other investigators. Carter said:

> . . . grade level achievement in arithmetic was consistently lower than that of other fields. The T-tests revealed no significant difference in the achievement of normal age girls and underage girls in arithmetic . . . (10, p. 103).

The fact that Carter's results were found at grade level suggests that his underage girls might even have achieved higher in arithmetic if their groups had been compared at the same chronological age.

Fuller said: "There is evidence that kindergarten children retain number concepts learned in kindergarten for considerable periods of time and are able to apply them in theory and practice later" (17, p. 14).

Haines concluded his study by saying that: "Academic advantages accruing from kindergarten experience are more pronounced in the areas of arithmetic than in reading" (21, p. 1817).

Fuller's and Haines' findings are important in terms of their implications for the timing, sequence, and the difficulty of the arithmetic curriculum. Thus the findings in this investigation, Carter's study, Fuller's summary of the research and Haines' more recent findings support the following assertion made by Brownell about American arithmetic instruction upon his return from Scotland and England:

> 1. We have seriously underestimated the attention span of school beginners. 2. Likewise, we have seriously underrated the 'readiness' of school beginners for systematic study. 3. We can safely ask children in the lower grades to learn much more in arithmetic than we are now asking them to learn (6, p. 165-177).

Brownell's point of view was preceded by Buswell, who had compared California children with English children in arithmetic achievement. Buswell concluded his study by saying that the English

> ... pupils at age eleven show a two-to-one superiority in arithmetical achievement as compared with pupils in a similarly selected sample in California of the same chronological age and following its customary procedures. (9, p. 9).

Thus the previous discussion and findings have the following implications for developmental theory and the higher arithmetic achievement of the early entrants: (1) The arithmetic age comparison results in this investigation are consistent with the findings by Fuller (19), Carter (10), and Haines (21), and these investigations as a whole tend to support Brownell's and Buswell's contention that pupils of the American grade schools can learn earlier in life, can learn more complex arithmetic, and that such learnings may have an enduring cumulative effect at age eleven. In terms of developmental theory the child who is more mature is ready for more nurture and therefore should be challenged by it so that his maximum development may result. (2) Evidence suggests that the arithmetic curriculum has not been sufficiently stimulating to some portions of the school children in the United States. If children are deprived of nurture or a curriculum experience when they are ready, developmental theory holds that a corresponding lack of achievement will result. Insofar as this sample is concerned, it is not known whether the arithmetic

curriculum was sufficient or insufficient to nurture optimum development of the late entrants. (3) The fact that the early entrants in this investigation and the underage girls in Carter's investigation had higher arithmetic achievement, may be explained by the fact that the arithmetic experiences timed for late entrants were too easy for them but sufficient and more challenging for the early entrants.

Extra schooling may have provided prerequisite number concepts and sequences at the teachable moment on which subsequent learning tasks are dependent. Thus it is possible that the early entrants benefited from a curriculum that may have been intended for more mature children and that fortunately was more successful in nurturing the growth of the early entrants.

Therefore, under the previous circumstances, one cannot deny that the earlier and consequently greater schooling of the early entrants resulted in greater arithmetic achievement. However, early entrant superiority in arithmetic achievement cannot be construed either to confirm or to deny the efficacy of developmental theory in view of the evidence that sufficient nurture or curriculum experiences may have been lacking in the development of the late entrants.

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